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INTRODUCTORY NOTES TO A STUDY OF CITRUS SCAB.

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The following three methods suggest themselves for the control of plagues such as citrus scab: spraying, injection, and absorption through roots. That is, it seems natural to apply something to the surface of the parts attacked which will either kill the fungus or prevent it from germinating, or to inject into the tree, or have the tree absorb through its leaves or roots, some substance that will be harmful to the fungus but not to the tree. It has been found by experience that different animals as well as different plants are killed or more or less injured by specific poisons.

C O P P E R. - The discovery that copper is a specific poison to fungi brought about the practice of spraying with Bordeaux mixture for most fungus diseases. It has been found that Bordeaux mixture has its limitation not because of the resistance of fungi to copper but rather because of the practical difficulties involved in its application. These difficulties are especially great in fruit and foliage only, it is evident that spraying should be confined to those parts which are young, but considering that fruit and foliage are formed more or less continually, spraying must be repeated often in order to protect the newly formed parts from the attack of scab. It is true, of course, that some of the new growth produces but little or no fruit and for that reason it may not be commercially profitable to spray it. The argument that all new growth should be sprayed in order to destroy all sources of infection is not valid in Puerto Rico. There are possible sources of infection in any grove regardless of the thoroughness of spraying.

The limitations of Bordeaux mixture in the control of citrus scab may be that of failing to cover all new growth. Frequently the upper side of the leaf or fruit is covered whereas the lower side is not. The poor result from spraying may also be due to the failure of spraying when it is most needed. The latter especially is a requirement which is very often difficult to meet. For instance, the trees may be well fertilized in anticipation of a new crop, then when rain comes the flush of foliage is liable to be very vigorous. The bloom is liable to develop so fast that it is practically impossible to get it all sprayed before the petals fall. If it is not sprayed at that time some scab is liable to develop, and whatever does develop will persist until the fruit ripens regardless of the number of sprayings that may be made later. The second application may be delayed because the first one was, or because of rainy weather. The rule that the second application should follow the first one within two weeks is not always applicable to

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Puerto Rico. The growth here is so fast at times that much infection may take place after one week. Whether it will or not depends upon several factors, namely if there is new tissue not covered by the spray residue, if the air surrounding the tissue is moist and, of course, if fungus spores are present. From the foregoing discussion it is evident that a severe outbreak of scab may be neither the fault of the spray used nor of the person using it. In other words Bordeaux mixture may be the best scab combatant known at present and yet it may at times fail to produce the desired result. But unfortunately Bordeaux mixture is so objectionable for other reasons that it seems imperative to find some other control measure against scab and melanose as well.

The first objection to Bordeaux mixture is that it kills the fungi which naturally keep the scale insects in check and that is a very serious objection in Puerto Rico. The second objection is that it has a harmful effect on the citrus tree. That objection is also serious in Puerto Rico where the sprayings are so frequent as to keep all the leaves covered with Bordeaux most of the time. If it were practicable to spray but one or two flushes of new growth a year, - and it sometimes is practicable, - then the damage would not be so serious. If it were practicable - and to some extent it is, - to spray the young growth without entirely covering the old leaves, the damage would be lessened. There is no reason for spraying a leaf that is more than one-half inch wide nor a fruit that is more than three-fourths of an inch in diameter. This is according to observations by John R. Winston in Florida. In Puerto Rico where the growth is often extra vigorous it may be well to make an extra allowance for size. The present practice of keeping all the leaves covered almost constantly with a layer of Bordeaux mixture is fatal to the tree. Yet it is indisputable that the practical difficulties are many and the question "to spray or not to spray" with Bordeaux is a difficult one to answer.

S U L P H U R. - It is well recognized that the potency of sulphur as a fungicide is below that of copper. Yet some growers prefer it because it is less harmful to the tree and it does kill rust mites and young uncovered scale insects. Several attempts have been made by the writer to compare the effect of Bordeaux mixture and lime-sulphur by noting the amount of scabby fruit going through the packinghouse from groves treated with the two sprays, but the results have not been conclusive. The fact is that the results from spraying are always erratic because of the many uncontrollable factors encountered in the field. For instance, single trees or a block of trees in a grove may be practically free from scab whereas other blocks are severely attacked. Frequently scab may be controlled nearly 100% on a block of trees whereas on another block the control may be less than 50%. The thoroughness of application and the time of application, even within 24 hours, may cause such a difference. Bordeaux and sulphur sprays are principally protective, that is, when the surface of foliage and fruit is covered with those sprays the underlying tissue is protected because the fungus spores are killed before they penetrate the covering. Sprays containing soluble chemicals that may enter the plant tissue are unsuitable in a case like this, for any

spray that is a valuable disinfectant is also liable to kill the young tender tissue of the host plant. It is conceivable that old mature leaves of citrus may be made to absorb chemicals which may be translocated in the tissue into the new growth and there serve as a disinfectant. But the practicability of that is, of course, merely a conjecture.

D U S T I N G. - Copper or sulphur, as well as many other fungicides, may be applied in the form of dust. The results from dusting are generally reported to be less satisfactory than those from spraying. The reason for that must be sought in the difference of adhesiveness. If a dust could be prepared that would adhere to the foliage and fruit as well as the same ingredients adhere when applied as a spray the results would probably be the same. It is obvious that dusting affords a great saving in time and that therefore it is more nearly possible to make the application when needed than it is with spraying. The aim should be, therefore, to make dusting more efficient as long as a covering of some sort must be applied to the leaves and fruit.

I N J E C T I O N. - The method of injecting chemicals into a tree is not far enough developed to even guess how practicable it may be. Theoretically it seems feasible but practically it may prove to be valueless.

ABSORPTION THROUGH ROOTS. - It is, perhaps, superfluous to state that the roots may absorb many elements or chemical combinations of elements that are not usually classed among the plant nutrients. The lithium nitrate reported upon in No. 60 of these Agricultural Notes, is a good example. Lithium, in minute quantities, may be absorbed by a plant without harmful effects but any considerable amount of it is fatally poisonous. That is true of many other chemicals, and the question arises: To what extent may such chemicals be a protection to the tree?

In connection with absorption through roots the subject of fertilizing naturally presents itself. In considering that subject in connection with scab the following factors are basic: (1) Nitrogen is necessary for new growth; (2) an abundance of nitrogen produces extra vigorous tissue, which is especially susceptible to scab; (3) potash has a tendency to make the tissue firm. Therefore the question arises: Will potash serve as a corrective in this case? If so, how much should be used and when should it be applied?

While further development of the control measures discussed in this article will be undertaken, it is hoped that additional knowledge, fundamental to the subject, may suggest other methods. With that in view the first work, along the line of scab control, in this laboratory, has been an attempt to acquire such knowledge. The progress of that work will be reported upon in the next article.

